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wherein said code for testing operates on pixels within each region to determine those ones of the plurality of regions that are predominantly skin color, and said code for subjecting causes the further facial feature analysis to be performed on only those regions determined to be predominantly of skin color.

REMARKS

This application has been carefully reviewed in light of the Office Action dated August 27, 2002 (Paper No. 7). Claims 31 to 65 are currently in the application, with Claims 1 to 30 having been canceled herein. Claims 31, 56 and 61 are the independent claims. Reconsideration and further examination are respectfully requested.

Claim 17 was objected to for an informality. Since Claim 17 has been canceled, the objection is rendered moot.

Claims 1 to 65 were rejected under 35 U.S.C. § 102(e) over U.S. Patent No. 6,188,777 (Darrell). Without conceding the correctness of this rejection, Applicants have canceled Claims 1 to 30. Accordingly, the § 102(e) rejection of Claims 1 to 30 is rendered moot. With respect to Claims 31 to 65, Applicants respectfully traverse the rejection for at least the following reasons.

The present invention concerns the detection of a face in a color digital image formed of a plurality of pixels. According to one aspect of the invention, the pixels of the color digital image are tested to determine those pixels having predominantly skin color. The testing of pixels is performed utilizing at least one image capture condition that is provided with the color digital image. By using image capture conditions, such as a

reading from a light meter, an appropriate color distribution model can be selected to account for differences in settings and performance characteristics of devices used to capture color digital images. Furthermore, by using an image capture condition provided with the color digital image, a wider range of color models can be devised and selected for use in testing the pixels without requiring additional user interaction.

With reference to particular claim language, independent Claims 31, 56 and 61 concern the detection of a face in a color digital image formed of a plurality of pixels. The plurality of pixels are tested to determine those pixels having predominantly skin color, where the testing utilizes at least one image capture condition provided with the color digital image. Those pixels determined as having predominantly skin color are subjected to further facial feature analysis while those pixels not having predominantly skin color are not subjected to further facial feature analysis.

The applied reference is not understood to disclose the foregoing features of the present invention. In particular, Darrell is not understood to disclose at least the feature of testing the color of pixels of a color digital image using at least one image capture condition provided with the color digital image to determine those pixels having a predominantly skin color.

Darrell concerns a system for identifying and tracking an individual's face using various techniques. According to one aspect of the system described in Darrell, an image is analyzed to mark and track regions having homogenous color such as skin color. One technique described at column 7, lines 11 to 20, of Darrell, uses a Gaussian prior probability model or a K-Nearest Neighbor classifier to classify a pixel as being either skin

or non-skin. However, Darrell is not understood to use an image capture condition in classifying the pixels as skin or non-skin. Rather, as mentioned in column 6, lines 57 to 61, Darrell describes a classification strategy that is largely invariant to intensity or saturation in order to provide robustness under different lighting conditions, and therefore does not use an image capture condition. Therefore, Darrell is not understood to disclose at least the feature of testing the color of pixels of a color digital image using at least one image capture condition provided with the color digital image to determine those pixels having a predominantly skin color.

Accordingly, independent Claims 31, 56 and 61 are believed to be allowable over the applied reference. Reconsideration and withdrawal of the § 102(e) rejection of Claims 31, 56 and 61 are respectfully requested.

The other claims remaining in the application are dependent from the independent claims discussed above and are believed to be allowable over the applied reference for at least the same reasons. Because each dependent claim is deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing remarks, the entire application is believed to be in condition for allowance and such action is respectfully requested at the Examiner's earliest convenience.

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Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Canceled)
2. (Canceled)
3. (Canceled)
4. (Canceled)
5. (Canceled)
6. (Canceled)
7. (Canceled)
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17. (Canceled)

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19. (Canceled)

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23. (Canceled)

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25. (Canceled)

26. (Canceled)

27. (Canceled)

28. (Canceled)

29. (Canceled)

30. (Canceled)

31. (Amended) A method of detecting a face in a [colour] color digital image formed of a plurality of pixels, said method comprising the steps of:

[(i)] testing the [colour] color of [said] the plurality of pixels to determine those [said] pixels having predominantly skin [colour] color, [said] the testing [utilising]

utilizing at least one image capture condition provided with [said] the color digital image;
and

[(ii)] subjecting only [said] those pixels determined in said testing step [(i)] as having predominantly skin [colour] color to further facial feature analysis whereby those [said] pixels not having a predominantly skin [colour] color are not subjected to [said] the further facial feature analysis.

32. (Amended) A method according to claim 31, wherein [each said] the at least one image capture condition is acquired at a time [said] the color digital image is captured.

33. (Amended) A method according to claim 32, wherein [said] the color digital image is encoded according to a predetermined format and [said] the at least one image capture condition is represented as meta-data associated with [said] the predetermined format.

34. (Amended) A method according to claim 31 wherein [said] the at least one image capture condition comprises lighting conditions at a time [said] the color digital image was captured.

35. (Amended) A method according to claim 31, wherein said testing step [(i),] comprises the sub-step, preceding [said] the testing, of [: (a)] dividing [said] the color

digital image into a plurality of regions, each [said] region comprising a plurality of [said] pixels[; and],

wherein [said] the testing is performed on pixels within each [said] region to determine those ones of [said] the plurality of regions that are predominantly skin [colour] color, and said subjecting step [(ii)] comprises performing [said] the further facial feature analysis on only those [said] regions determined to be predominantly of skin [colour] color.

36. (Amended) A method according to claim 31, wherein said testing step [(i) utilises] utilizes at least one predetermined [colour] color distribution model, [said] the color distribution model having been generated using previously sampled facial image data.

37. (Amended) A method according to claim 36, wherein [said colour] the color distribution model is generated for a particular image capture device.

38. (Amended) A method according to claim 36, wherein separate [colour] color distribution models are generated for [said] different image capture conditions.

39. (Amended) A method according to claim 38, wherein [said] the at least one image capture condition comprises lighting conditions at a time [said] the color digital image was captured and separate [colour] color models are generated for different lighting conditions at a time [said] the previously sampled facial image data was captured.

40. (Amended) A method according to claim 39, wherein separate [colour] color distribution models are generated for groups of images taken with a flash and images taken without a flash.

41. (Amended) A method according to claim 39, wherein separate [colour] color distribution models are generated for groups of images taken indoors and images taken outdoors.

42. (Amended) A method according to claim 36, wherein each [said colour] color distribution model is represented as a frequency histogram of [colour] color representation vectors.

43. (Amended) A method according to claim 36, wherein each [said colour] color distribution model is represented as a probability distribution of [colour] color representation vectors.

44. (Amended) A method according to claim 36, wherein each [said colour] color distribution model is represented as a binary map of [colour] color representation vectors.

45. (Amended) A method according to claim 42, 43 or 44, wherein [said colour] the color representation vectors are derived from perceptual [colour] color space

values of [the] predetermined skin-[colour]color pixels in [said] the previously sampled facial image data.

46. (Amended) A method according to claim 42, 43 or 44, wherein [said colour] color representation vectors contain chromatic [colour] color values derived from those RGB values of [the] predetermined skin-[colour]color pixels in [said] the previously sampled facial image data.

47. (Amended) A method according to claim 44, wherein [said] the binary map comprises a percentage of the skin [colour] color pixels that were identified in [said] the previously sampled facial image data.

48. (Amended) A method according to claim 47, wherein one of [said] the plurality of pixels is classified as being skin [colour] color if the [colour] color representation vector corresponding thereto occurs within [said] the binary map.

49. (Amended) A method according to claim 42, wherein each of [said] the plurality of pixels is classified as being skin [colour] color if the frequency of the [colour] color representation vector corresponding thereto exceeds a predetermined threshold frequency.

50. (Amended) A method according to claim [44] 43, wherein each of

[said] the plurality of pixels is classified as being skin [colour] color if the probability of the [colour] color representation vector corresponding thereto exceeds a predetermined probability threshold.

51. (Amended) A method according to claim [48]35, wherein one [said] of the plurality of regions is determined to be predominantly skin [colour] color if more than a predetermined percentage of the total number of [said] pixels in [said] the one region are classified as being skin [colour] color.

52. (Amended) A method according to claim 35, wherein [said] the plurality of regions are geometrically divided from [said] the color digital image.

53. (Amended) A method according to claim 35, wherein [said] the plurality of regions are formed of pixels having substantially homogenous [colour] color.

54. (Amended) A method according to claim 53, wherein [said] the plurality of regions are formed using a region growing method based upon [colour] color differences.

55. (Amended) A method according to claim 35, wherein said [further analysis of] subjecting step [(ii)] is independent of face [colour] color.

56. (Amended) An [A] apparatus for detecting a face in a [colour] color digital image formed of a plurality of pixels, said apparatus comprising:

means for testing the [colour] color of [said] the plurality of pixels to determine those [said] pixels having predominantly skin [colour] color, said testing means [utilising] utilizing at least one image capture condition provided with [said] the color digital image; and

means for subjecting only [said] those pixels so determined as having predominantly skin [colour] color to further facial feature analysis whereby those [said] pixels not having a predominantly skin [colour] color are not subjected to [said] the further facial feature analysis.

57. (Amended) An[A] apparatus according to claim 56, wherein [each said] the at least one image capture condition is acquired at a time [said] the color digital image is captured.

58. (Amended) An[A] apparatus according to claim 57, wherein [said] the color digital image is encoded according to a predetermined format and [said] the at least one image capture condition is represented as meta-data associated with [said] the predetermined format.

59. (Amended) An[A] apparatus according to claim 56, wherein [said] the at least one image capture condition comprises lighting conditions at a time [said] the color

digital image was captured.

60. (Amended) An[A] apparatus according to claim 56, wherein said means for testing comprises means for dividing [said] the color digital image into a plurality of regions, each [said] region comprising a plurality of [said] pixels[;],

wherein said means for testing operates on pixels within each [said] region to determine those ones of [said] the plurality of regions that are predominantly skin [colour] color and said means for subjecting causes [said] the further facial feature analysis to be performed on only those [said] regions determined to be predominantly of skin [colour] color.

61. (Amended) A computer readable medium incorporating a computer program product for detecting a face in a [colour] color digital image formed of a plurality of pixels, said computer program product comprising code for:

[means for] testing the [colour] color of [said] the plurality of pixels to determine those [said] pixels having predominantly skin [colour] color, [said] the testing [utilising] utilizing at least one image capture condition provided with [said] the color digital image; and

[means for] subjecting only [said] those pixels so determined as having predominantly skin [colour] color to further facial feature analysis whereby those [said] pixels not having a predominantly skin [colour] color are not subjected to [said] the further facial feature analysis.

62. (Amended) A computer readable medium according to claim 61,
wherein [each said] the at least one image capture condition is acquired at a time [said] the
color digital image is captured.

63. (Amended) A computer readable medium according to claim 62,
wherein [said] the color digital image is encoded according to a predetermined format and
[said] the at least one image capture condition is represented as meta-data associated with
[said] the predetermined format.

64. (Amended) A computer readable medium according to claim 61,
wherein [said] the at least one image capture condition comprises lighting conditions at a
time [said] the color digital image was captured.

65. (Amended) A computer readable medium according to claim 61,
wherein said [means] code for testing comprises [means] code for dividing [said] the color
digital image into a plurality of regions, each [said] region comprising a plurality of [said]
pixels[;],

wherein said [means] code for testing operates on pixels within each [said]
region to determine those ones of [said] the plurality of regions that are predominantly skin
[colour] color, and said [means] code for subjecting causes [said] the further facial feature
analysis to be performed on only those [said] regions determined to be predominantly of
skin [colour] color.

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